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Spring 5-4-2015

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The Effectiveness of Graphic Organizers on Students' Attitudes Towards, Approaches to,  
and Accuracy When Solving Word Problems

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**Abstract**

This study examined how the use of a graphic organizer impacted students' approach and attitudes towards solving word problems. Word problem graphic organizers have great success in helping students to organize their thoughts and visualize the relationships between formal learned knowledge and the application of that knowledge. Through practice with the organizer, and both verbal and written assessments, the impact of the graphic organizer on students' organization and application of mathematical knowledge was examined.

## **Introduction**

Over the past few years, mathematics education has begun to shift away from the classic procedural type of learning into a more concept-based learning. A key part of this shift is the newfound importance of problem solving as a crucial part of the mathematics curriculum. In today's mathematics classroom, problem solving should play an important role in how students learn and explore new mathematical concepts. Problem solving requires students to apply the skills they have learned to different real-life situations (Cai, 2013). Mathematical tasks such as word problems will require the application of skills rather than the rote repetition of math facts (Gooding, 2009). Building students problem solving abilities is a fundamental part of mathematics that will carry them through all grades. However, problem solving should not be taught as a separate part of the mathematics curriculum but rather as an integrated part of each unit (Cai, 2013). Word problems are a realistic way for teachers to integrate students' learned mathematics skills with the application of important problem solving skills (Boonen, Schoot, Wesel, Vries, & Jolles, 2013).

## **Review of Literature**

### **Importance of Word Problems**

One method of learning and acquiring problem solving skills is through the use of word problems. The literature states that a word problem is any math exercise where significant background knowledge about the problem is presented as text rather than in math notation (Boonen, et al., 2013). Rather than simply asking students to complete a rote addition or subtraction exercise, word problems require that the student have a full and complete conceptual understanding of the material in order to be successful. According to McCarthy (2010), the use

of word problems fosters the idea of teaching for understanding because word problems require students to deepen their thinking and apply their knowledge. The literature is in consensus that word problems integrate formal school mathematics with real word problem solving by requiring students to apply the learned formal content. Well-written word problems stimulate mathematical thinking and compel students to expand upon what they know in order to investigate mathematical ideas in a new way (Cai, 2013). With multiple methods to get the same one answer, word problems further students' understanding of the mathematical ideas by demonstrating new approaches to problem solving. The use of word problems in a mathematics classroom encourages writing in mathematics; giving students an opportunity to develop their thinking and mathematics language through reasoning strategies. Word problems require students to compare, change, and combine numbers, requiring a high level of mathematical understanding and problem solving skills (Cai, 2013).

### **Elementary Students' Difficulties with Solving Word Problems**

Though very beneficial to students' mathematical problem solving skills, word problems place a heavy demand on students' information processing systems by requiring students to first understand the situation in the word problem, and to then understand what the problem is asking them to do. Word problems are complex and often require multiple steps to complete, a concept students might not be familiar with or have ever seen before. Word problems also require realistic answers when previously students may have not been taught to consider real-life factors and constraints (Gooding, 2009). There is a strong theme among the literature that solving word problems requires two phases from the students; first that they identify and comprehend what the problem is asking, and second that they plan and execute a solution. The first step requires that students have a strong understanding of the text in order to identify the problem hidden in the

text of the word problem (Boonen, et al., 2014), while the second step requires a strong visual representation and solution plan (Moran, Swanson, Gerber, & Fung, 2014). The area students get caught up in most often is the problem translation. Problem translation requires students to examine the text of the word problem, identify significant and insignificant information, and then summarize or restate the information through both a visual representation and a number sentence (Moran et al., 2014). Within the two phases, the first phase is usually the more difficult because students struggle with the text of word problems more than the solution to the problem (Boonen, et al., 2013). According to Sheriff and Boon (2014), word problems require students to first read the problem and understand the text meaning, then identify the relevant information in the problem while simultaneously disregarding the extraneous information, then to create an abstract mental representation, and finally decide their solution steps and solve the problem by carrying out the steps. For students who are transitioning from simple one-step problems, word problems are a completely new type of language and require a different kind of understanding. Compared to rote repetition of facts, word problems require students to create strong visual images, an area in which many children struggle (Boonen, Wesel, Jolles, & Schoot, 2014). If the student does not understand the problem enough to create a visual image or representation, they will not be able to succeed in solving the problem.

### **Word Problems and Reading Comprehension**

According to Boonen, et al., (2013), there is a direct relationship between a student's reading comprehension level and their ability to successfully understand and solve word problems. Word problems are highly language based and struggling readers may not recognize and interpret the verbal structures correctly (Kempert, Hardy, & Saalbach, 2011). A strong technical reading fluency is crucial to students problem solving skills however when initially teaching students

reading comprehension skills, the instruction barely goes beyond identifying the explicitly stated information, making the hidden meanings in word problems especially difficult for struggling readers (Kempert, et al., 2011). Students' difficulties with word problems are associated with their reading development and students who do have reading disabilities will progress more slowly when solving word problems (Vilenius-Tuohimaa, Aunola, & Nurmi, 2014).

Mathematical word problems include new and unfamiliar vocabulary for students such as key word phrases like "less than" and "more than" (Boonen, et al., 2013). By combining words, numerals, letters, symbols, and graphics, word problems create a new type of language for students to learn and understand. This combination of words, numerals, letters, symbols, and graphics makes mathematics the most difficult area to read because there are more concepts per word, sentence, and paragraph than any other subject (Braselton & Decker, 1994).

### **English Language Learners**

English Language Learners (ELLs) are identified as the most strongly disadvantaged students in the elementary classroom (Kempert, et al., 2011). This disadvantage can stem from their lack of proficiency of the English language due to their immigrant backgrounds (Kempert, et al., 2011). Having a lack of the instructional language immediately sets them behind other students in the classroom, which becomes very evident during the comprehension of mathematics.

Without a working knowledge of mathematics language, English Language Learners have a hampered initial comprehension of the mathematics vocabulary and the steps necessary to solve any type of problem. The oral and written language required by ELLs to complete word problems successfully is much more complex than numeric computations (Kempert, et al., 2011). The literature states that there are two types of ELLs, dominate and balanced. Dominate ELLs have a high proficiency in their native language while balanced ELLs have equal proficiency

between languages. The students who are dominate ELLs have a much harder time succeeding in the mathematics classroom (Kempert, et al., 2011). Mathematics, and word problems specifically, are strongly linked to language and experiences. Another setback ELLs with an immigrant background face is real life constraints because they cannot connect to the word problem topic (Bernardo & Calleja, 2005). Students who are from South America have likely never had experience with snow, and a word problem that asks about the area of the snow in their yard would be very difficult for these students to understand and begin to solve. Without an initial understanding of the language of the problem, students cannot create a visual representation, making word problems very difficult to solve.

### **Gender differences**

The literature has not found any significant differences in the ability of boys and girls to solve mathematics word problems. However in an elementary classroom, girls are often better readers, which gives them a slight advantage when solving word problems because word problems are so highly linked to language (Vilenius-Tuohimaa, et al., 2014). Girls also have higher linguistic and reflective thinking levels, making their communication of their problem solving abilities much more elaborate and detailed (Sen, 2013).

### **Graphic Organizers in the Classroom**

Graphic organizers are very effective and useful tools across subjects for students who struggle with reading comprehension (Sheriff & Boon, 2014). The use of graphic organizers helps students make connections and visualize the relationships between general concepts or topics. For visual learners, students who have trouble organizing their thoughts, or students who struggle to see relationships between concepts, graphic organizers serve as a place to visualize connections and organize information. According to Zollman (2009), fourth grade students who



used graphic organizers to arrange their ideas improved both their reading comprehension and communication skills. These organizers work well for the elementary level reading and writing process because they allow students to brainstorm ideas without being concerned about the correct order or the correct solutions. One of the main benefits of using graphic organizers in the classroom is that they are a good tool for differentiation. Graphic organizers provide starting points for the lower-ability students, help average-ability students organize their thoughts, and help high-ability students improve their communication skills (Zollman, 2009). The use of graphic organizers in an elementary classroom encourages students to write down their thinking process, giving the students the opportunity to expand on those thoughts and deepen their understanding of the topic. Graphic organizers are also a quick assessment for teachers to see what the students understand and where any misconceptions may be (Zollman, 2009). The use of these organizers helps teachers to evaluate students independently and design assessment that meets the students at their academic level, rather than with an assessment that is high above their depth of understanding (“Ways to make,” 1995).

### **Graphic Organizers in the Mathematics Classroom**

The primary purpose of using graphic organizers in the classroom is to help students see relationships between the information and the concepts learned in class. This concept is directly translated to mathematics education because the use of graphic organizers in the mathematics classroom helps students to see that mathematical thinking does not have to be a linear activity (Zollman, 2009). Using graphic organizers to solve word problems requires that all students start and end at the same point, but allows the students to take their own path to get there. Students can look at and organize the word problems in a way that makes sense to them and their academic level rather than following a strict procedural guideline (Braselton & Decker, 1994).

The use of graphic organizers helps students understand the problem by not requiring them to process as much specific language information. Rather than reading a problem and trying to understand it as a whole, students can sort the essential and nonessential information and look at the problem as pieces (Zollman, 2009). When solving word problems, many students try to rely on their visual reasoning skills to connect mathematics elements, and the graphic organizer gives them a place to do that (Ives & Hoy, 2013). Zollman (2009) conducted a study in a fourth grade classroom using a word problems graphing organizer titled “Four Corners & a Diamond” that was a piece of paper divided into four sections with a diamond in the center of the paper. The four corner sections were titled “What do you know?”, “Brainstorm ways to solve the problem”, “Try it out!”, “Which did you choose & why?”, and the diamond in the middle asked the question “What do you need to find out?”. This graphic organizer is arranged in such a way that order does not matter; students can fill out the sections as they have ideas and they do not have to follow a step-by-step process that only has students look for key words. At the conclusion of his research, Zollman (2009) noted that the students oral retelling of their thinking went from simple to detailed and explained thinking. The use of the graphic organizer also gave the teacher a way to quickly notice in which areas the students were lacking.

Another type of word problem graphic organizer used by Braselton and Decker in a fifth grade classroom (1994), had students first restate the question, find needed data, plan what to do, find the answer by showing their steps, and finally check if their answer was reasonable. This graphic organizer has a more linear approach to solving word problems as the headings were arranged vertically on a page, suggesting that students should go in the order they are listed. Braselton and Decker (1994) also had students work in cooperative learning groups, which resulted in students broadening their word problem solving abilities by seeing how other students

went about solving the same problem. At the completion of this study, Braselton and Decker (1994) also noted that students had marked improvements in problem solving and the ability to communicate their problem solving thinking. Students who started out the study with weak problem solving skills benefitted from the visual organization provided from the graphic organizers (Braselton & Decker, 1994).

### **Present Study**

For this action research project I will study the impact of the using a graphic organizer in a third grade classroom. This study will specifically examine how the use of the graphic organizer impacts students' approach and attitudes towards solving word problems. As shown in Braselton and Decker (1994) and Zollman (2009), word problem graphic organizers have great success in helping students to organize their thoughts and visualize the relationships between formal learned knowledge and the application of that knowledge. This present study will also examine how the use of the graphic organizer differs between high achieving mathematics students and low achieving mathematics students. This paper will address the following research questions:

1. How does the use of a graphic organizer affect students' approach towards solving word problems?
2. How does the use of a graphic organizer affect students' attitudes towards word problems?
3. How does the use of a graphic organizer impact students' accuracy when solving word problems?
4. How does the use of a graphic organizer affect various demographic subgroups' attitudes towards, approach to, and accuracy when solving word problems?

5. Is there a difference in the effect of graphic organizers on high achieving mathematics students and low achieving mathematics students approach towards and accuracy when solving word problems?

### **Methodology**

The research questions were answered through an action research project in the spring of 2015 within a 3<sup>rd</sup> grade classroom. According to Parsons and Brown (2002), action research is defined as “a form of investigation designed for use by teachers to attempt to solve problems and improve professional practices in their own classrooms.” As stated in the literature review, word problems represent a crucial part of problem solving that requires students to apply the skills they have learned to real-life situations (Gooding, 2009). However, word problems require students to compare, change, and combine numbers and can be overwhelming (Cai, 2013). This action research project investigates how the use of a graphic organizer (Appendix A) improved students’ success and confidence when solving word problems by helping to organize and clarify their thinking. For the purpose of this study, a word problem was defined as any math exercise where background knowledge about the problem is presented as text rather than in math notation.

### **Setting and Participants**

The elementary school in this study was located in a high-need, high-poverty community and is a Title 1 public elementary school in Central Virginia. The school population is 591 students and 100% of the students in this school were a part of the free and reduced lunch program.

This action research study took place in a third grade classroom. Within this study there were nine females and eleven males. The demographics of this classroom were two Caucasian students, seven Hispanic students, thirty Black or African American students, and seven English

Language Learners. Prior to this study, students were divided into two different classes based on their academic level; there was a high-level mathematics class with twenty-two students and a low-level mathematics class with seventeen students. There were nine females and eight males in the low-level mathematics class, eleven females and eleven males in the high-level mathematics class, and six of the seven English Language Learners were in the low-level mathematics class. Both groups of students received the graphic organizer and were given instruction on how to use it to solve word problems. In total, there were forty students who participated in the implementation of this instructional strategy. These students were selected to participate in the study because they are a part of the class in which I completed my student teaching internship as a part of my Master's degree.

### **Procedures**

There were a number of scheduling and instructional conflicts, discussed in the limitations, which prevented the original methodology to occur. The original timeline is shown in Figure 1 and the actual timeline is shown in Figure 2.

In the three weeks leading up to this study students were given oral pre-assessments. The oral pre-assessment was comprised of a series of word problem questions (Appendix B) that the students completed independently while I observed. Upon the completion of the word problems, students were asked a series of questions (Appendix C) that orally assessed their approach to and attitudes towards solving word problems. After the pre-assessment, I examined students' accuracy scores and overall approaches and attitudes to word problems and tailored my instruction to meet their needs.

To implement this strategy students were first showed the graphic organizer and each component was reviewed as a class. During the first week with the graphic organizer I modeled

for students the correct way to read word problems and then complete the graphic organizer as a class. The second half of the first week of the study students were to have received their own graphic organizers to fill in while word problems were solved as a class. During weeks two and three students would have worked in groups and with teacher support to solve the word problems and complete their graphic organizer. At two points during the six-week study there were to be refresher lessons to keep the components of the graphic organizer relevant for students. The first refresher lesson was to have occurred during week three of the study and consisted of a review of the different parts of the graphic organizer and the best way to read a word problem. By weeks four through six students should have been completing the graphic organizer and solving word problems on their own as a part of class work and tests or quizzes. Another refresher lesson would have occurred during week five and was a group work lesson on using the graphic organizer. During this lesson students were to be given a large graphic organizer to complete in their groups. Throughout these six weeks students practiced word problems about fractions, area, volume, and perimeter. Each unit had word problems associated with it that could be completed using the graphic organizer. In addition to the refresher lessons on the graphic organizer, students received the regular curriculum instruction on the unit topics.

Upon the completion of this study, the students were again given individual oral-assessments. This oral post-assessment (Appendix D) was identical to the pre-assessment except it served to show the success of the graphic organizer as an instructional strategy. This post-assessment also required students to solve word problems and answer questions about their attitudes and approaches towards word problems (Appendix E). The questions in the post-assessment were different than the pre-assessment but of similar difficulty levels.

Weeks	Course of Instruction
3 weeks prior	Pre Oral and Written Assessment
Week 1	Review and Model Graphic Organizer
Week 2	Begin independent use of graphic organizer
Week 3	Refresher Lesson #1
Week 4	Students use Graphic Organizer independent
Week 5	Refresher Lesson #2
Week 6	Continue Independent Use
Post-Study	Post Oral and Written Assessment

*Figure 1: Table displaying the planned timeline for instruction of the graphic organizer.*

Weeks	Course of Instruction
3 weeks prior	Pre Oral and Written Assessment
Week 1	Review and Model Graphic Organizer
Week 2	Graphic organizer available to students
Week 3	Graphic organizer available to students
Week 4	Graphic organizer available to students
Week 5	Graphic organizer available to students
Week 6	Independent Use and Modeling as a Class
Post-Study	Post Oral and Written Assessment

*Figure 2: Table displaying the actual timeline for the instruction of the graphic organizer.*

### **Data Collection**

For this study there were twenty students who were observed before and after the implementation of the graphic organizer. Each student was assigned a unique identification code

to ensure confidentiality of the students. The qualitative data in this study was collected through oral pre- and post-assessments. This type of oral assessment aided in the graphic organizer instructional strategy because it allowed catered instruction to meet the needs of the students. The pre- and post- assessments show the impact the graphic organizer instructional strategy has on the students. A benefit of using oral-assessments is that often students do not test well, and this eliminates any error due to poor test-taking abilities. The pre- and post-assessments were conducted in the hallway outside of the classroom to ensure confidentiality between the students and the rest of the class. These assessments were not audio- or video- recorded. The pre- and post-assessments consisted of four written word problems and six oral questions. Throughout the written completion of the word problems data was collected by writing down observations about students' attitudes and approaches towards the problems. Throughout the oral questions, data was collected by writing down observations of students' responses to the questions. Oral pre- and post-assessments were used because students in third grade can express themselves through spoken word successfully and will give a strong sense of their approach to word problem solving. The use of a pre- and post-assessment also displayed the impact that this instructional strategy has on the students' thinking. The quantitative data in this study was collected by grading the students written word problem responses for accuracy before and after the implementation of the graphic organizer strategy.

### **Data Analysis**

After the oral pre-assessment all of the notes from the students were taken and studied to look for themes and similarities between their approach and attitudes towards word problems. Their accuracy scores on the six word problems were examined to find an average score. The average scores of the high students, low students, boys, girls, and ELL students in the class were



also examined. After the post-assessment, all of the notes were studied to find themes and similarities between students' approach and attitudes towards word problems. The accuracy scores of the post-assessment word problems were studied to find an average for the whole group and the subgroups. Once both the pre- and post-assessment data was collected, coded, and averaged, the data was compared. The themes of students' attitudes approaches to word problems before and after the implementation of the graphic organizer were compared. Accuracy scores for the whole group and the subgroups before and after the implementation of the word problems were studied by comparing the average scores. The themes and coding scheme for the pre- and post-assessments were created after examining the data. The average scores were studied by comparing the means of each set of data before and after the implementation of the graphic organizer.

**Results**

Student Code	Pre-Test Score	Post-Test Score	Net Gains/Losses
CRm10	25%	75%	+50%
SMf14	75%	75%	0
HIfEI14	0%	75%	+75%
RYm15	75%	100%	+25%
OBf8	50%	100%	+50%
TCm1	75%	100%	+25%
ASfE2	50%	75%	+25%
AMmE11	50%	50%	0
DBmE6	50%	50%	0
CDm13	25%	100%	+75%
CNfE15	75%	100%	+25%
MCf2	25%	100%	+75%
OMf20	75%	100%	+25%
MCm16	75%	100%	+25%
RMmE9	75%	100%	+25%
WRm8	25%	75%	+50%
WNm7	0%	100%	+100%
CTfI14	25%	75%	+50%
WEm17	25%	75%	+50%
Average	49%	88%	+39%

*Figure 3: Table displaying all students' pre-test, post-test scores, and net gains or losses.*

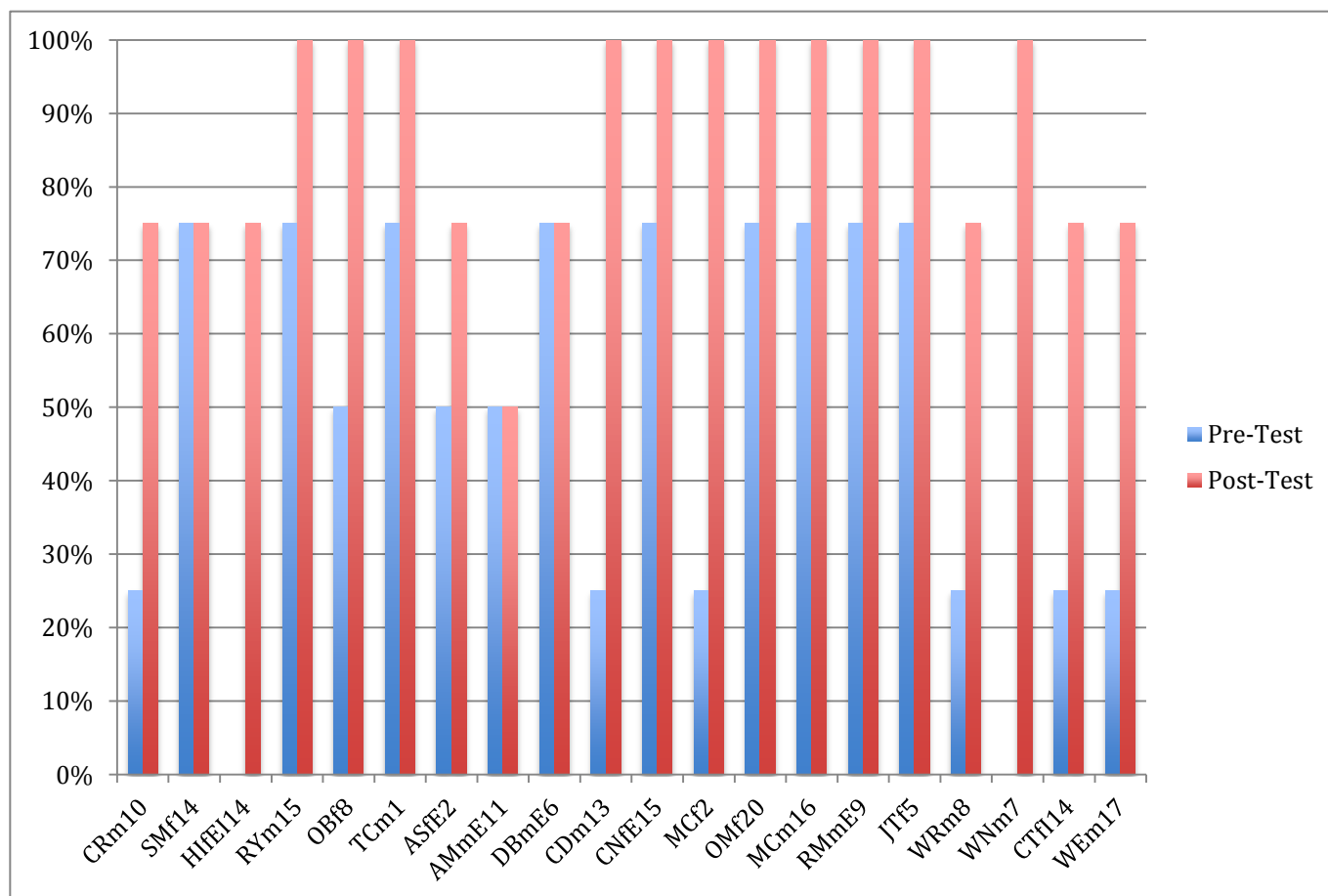


Figure 4: Graph comparing students' pre-test and post-test scores.

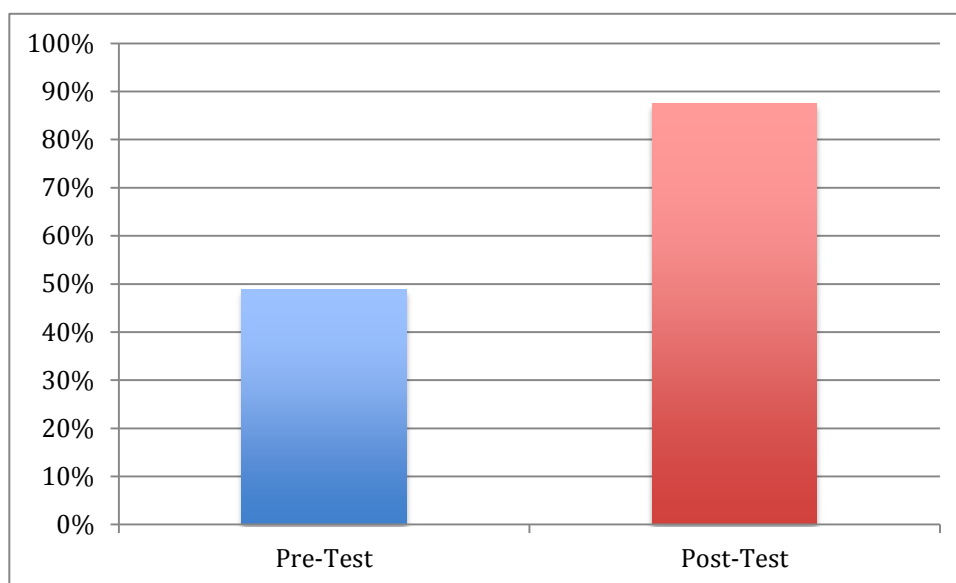


Figure 5: Graph comparing pre-test and post-test average scores of all students.

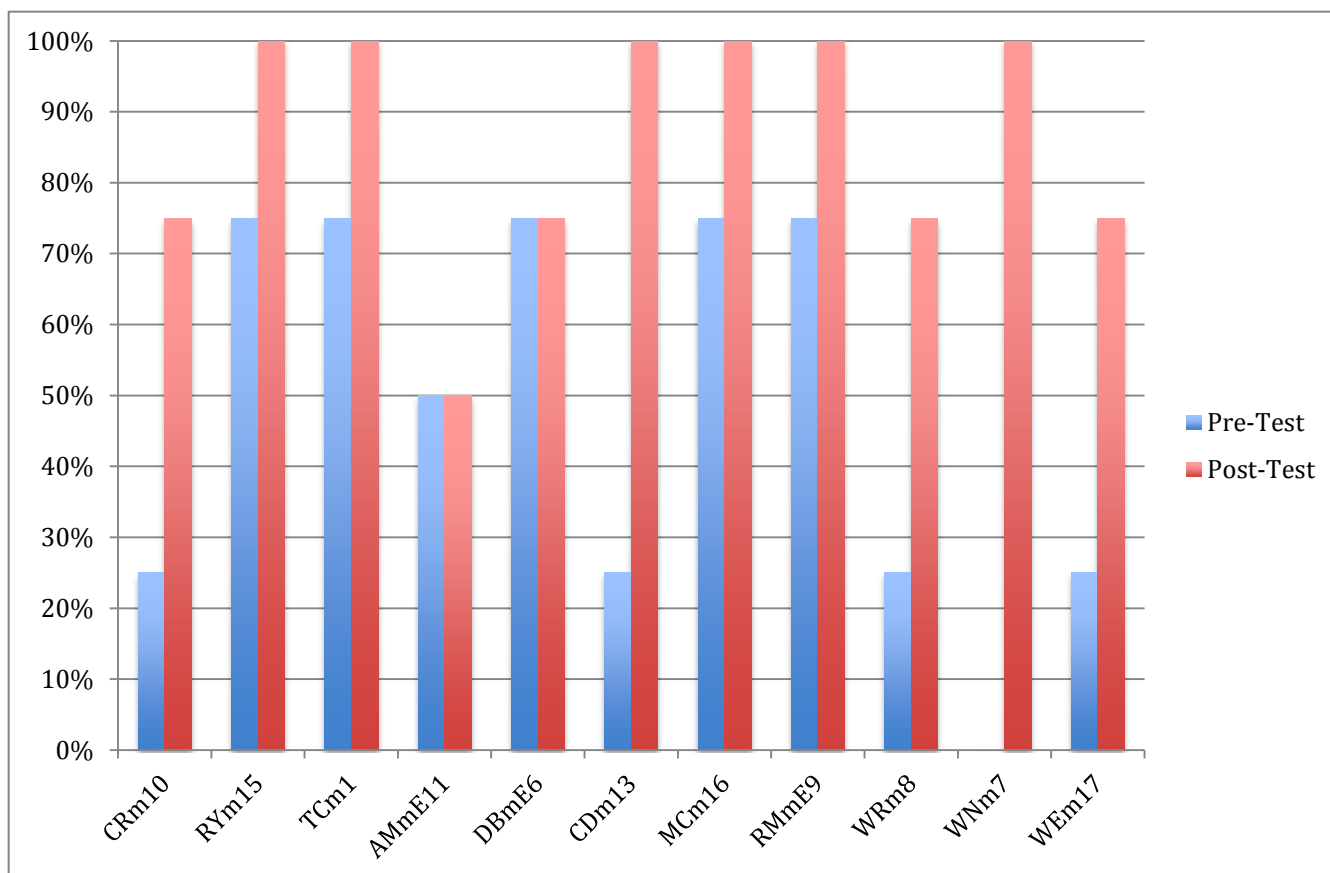


Figure 6: Graph comparing the pre-test and post-test scores of the male students.

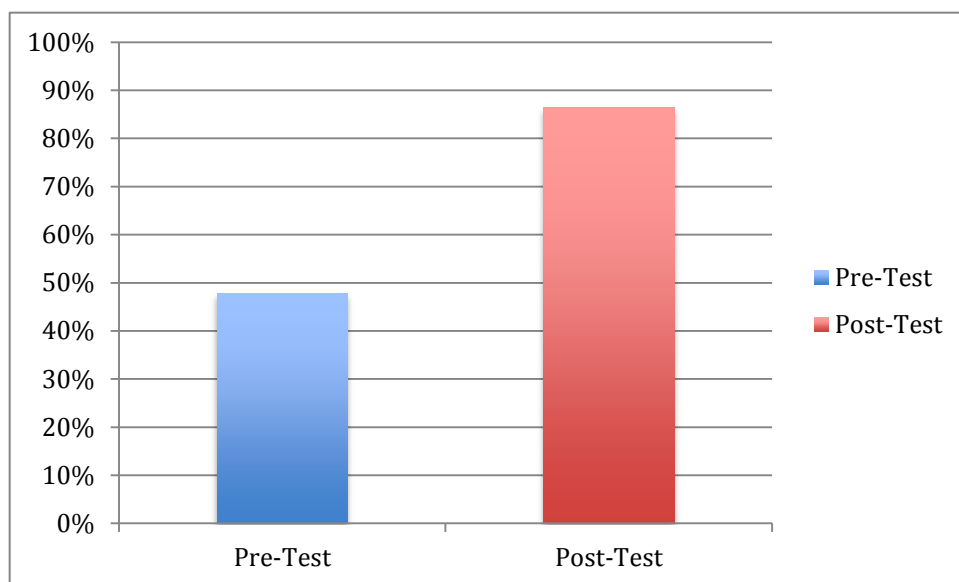


Figure 7: Graph comparing the pre-test and post-test average scores of the male students.

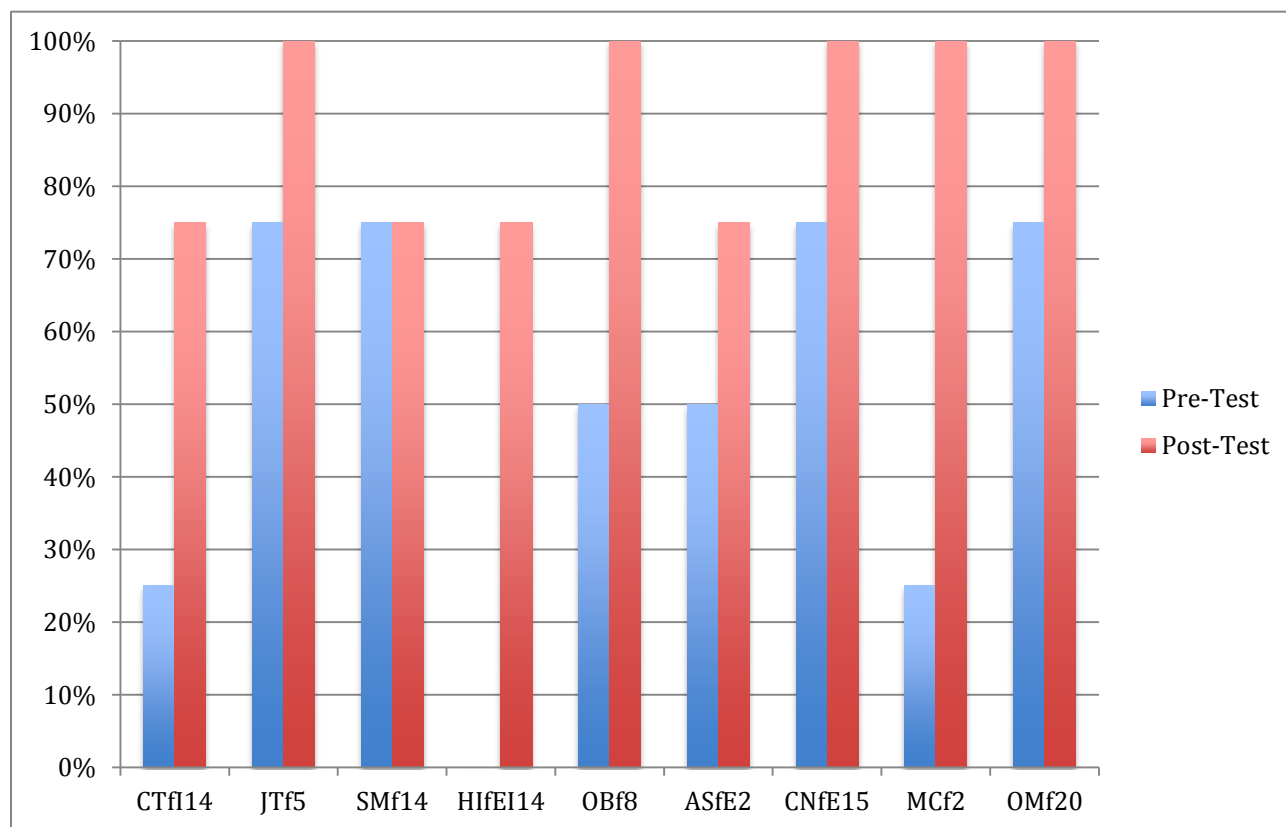


Figure 8: Graph comparing the pre-test and post-test scores of the female students.

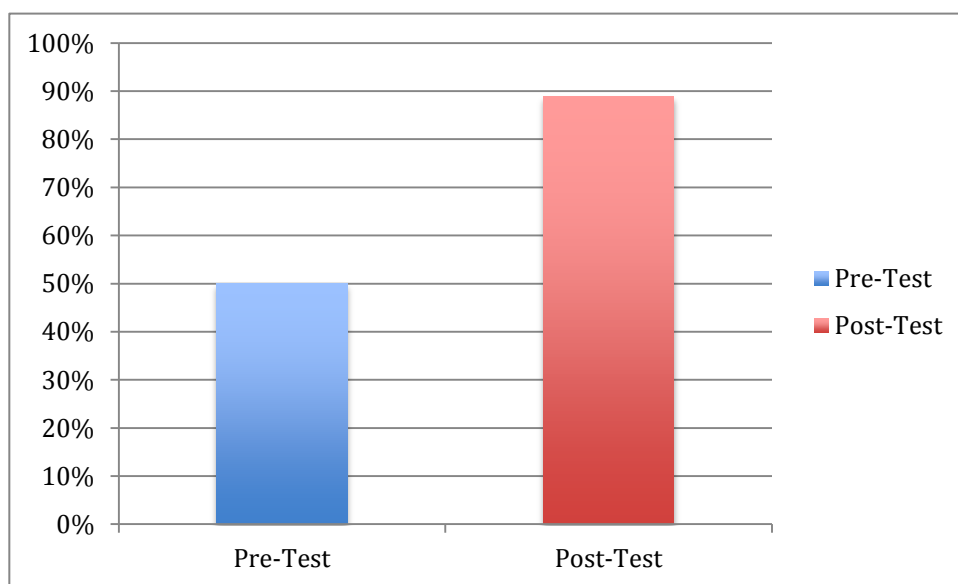


Figure 9: Graph comparing the pre-test and post-test average scores of the female students.

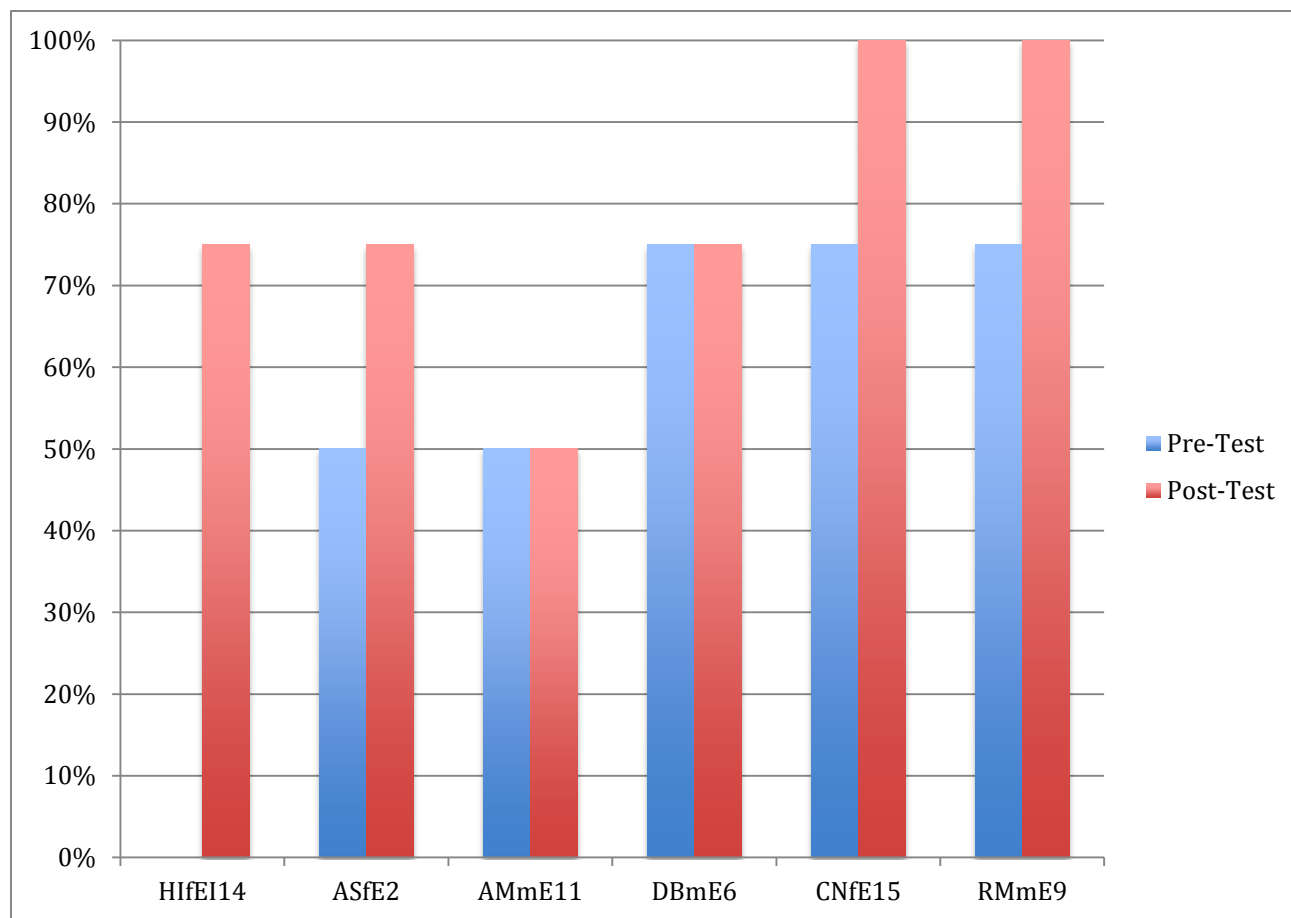


Figure 10: Graph comparing the pre-test and post-test scores of the ELL students.

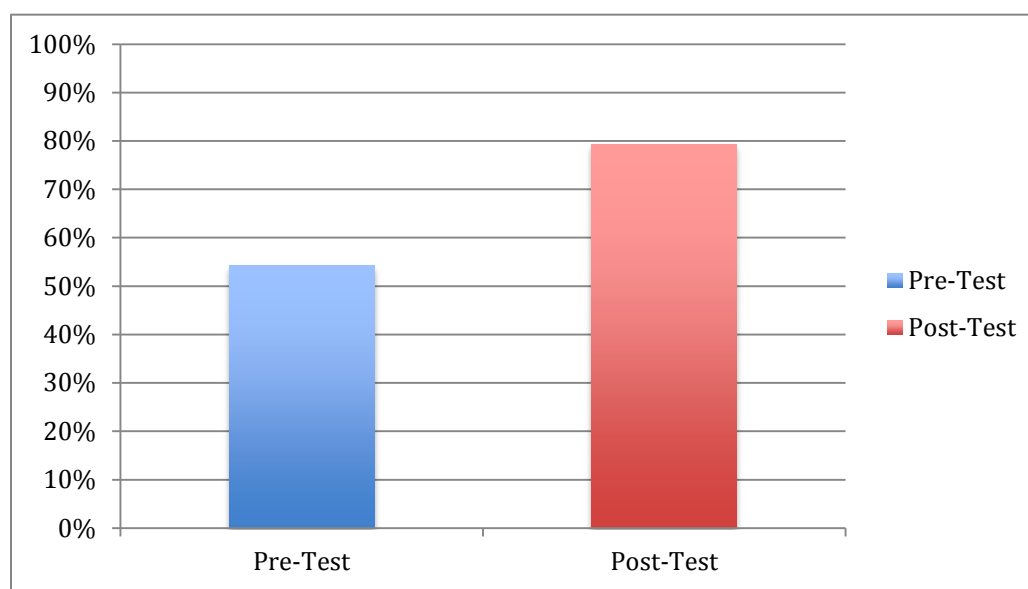


Figure 11: Graph comparing the pre-test and post-test average scores of the ELL students.

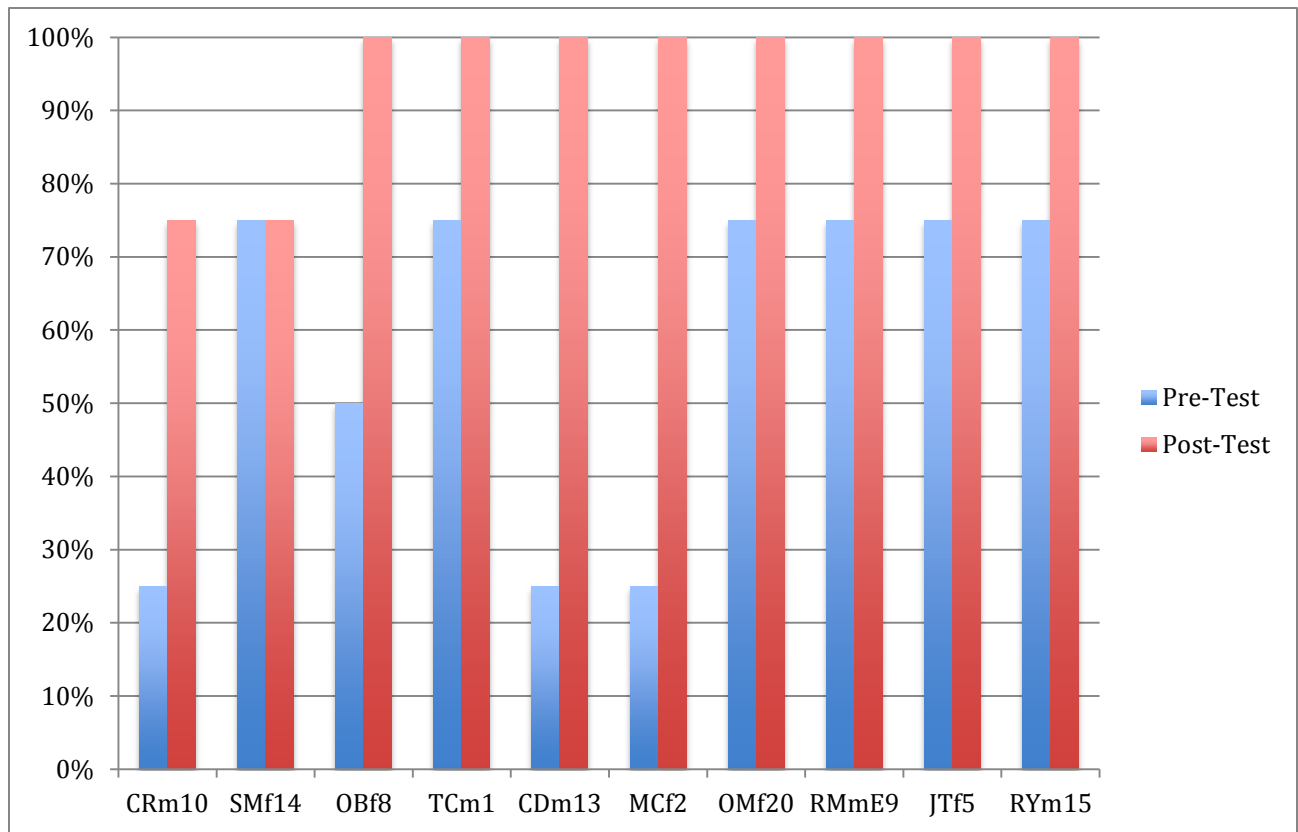


Figure 12: Graph comparing the pre-test and post-test scores of the high-achieving mathematics students.

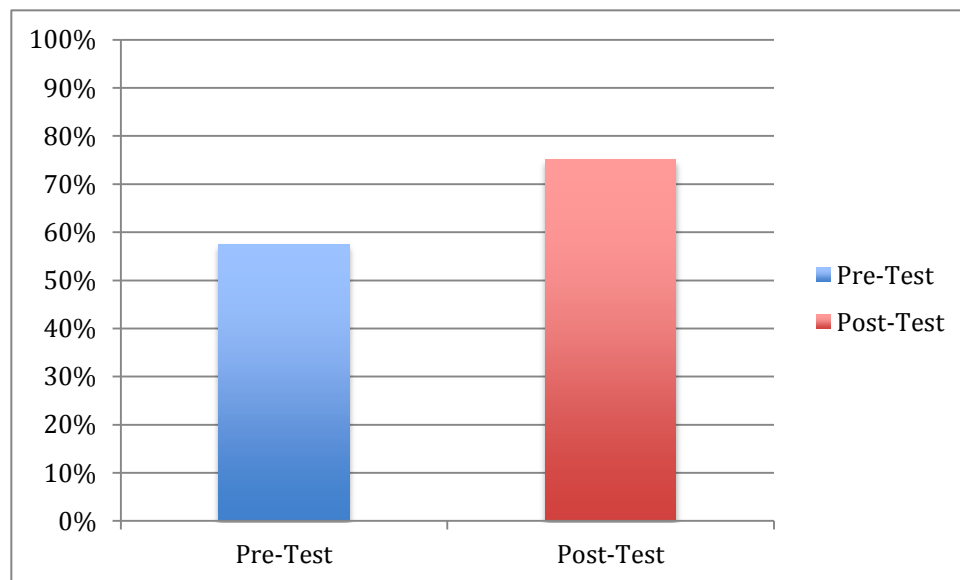


Figure 13: Graph comparing the pre-test and post-test average scores of the high-achieving mathematics students.

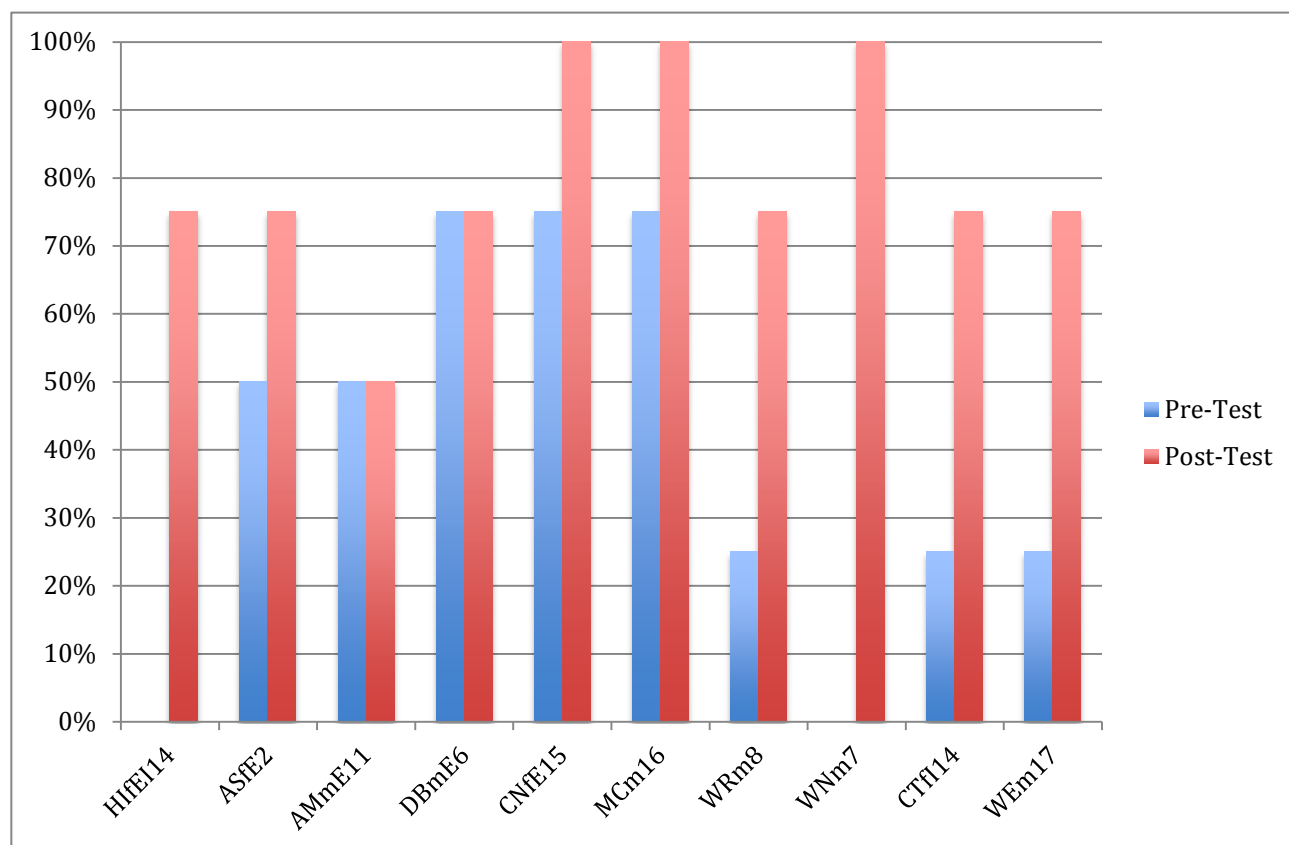


Figure 14: Graph comparing the pre-test and post-test scores of low-achieving mathematics students.

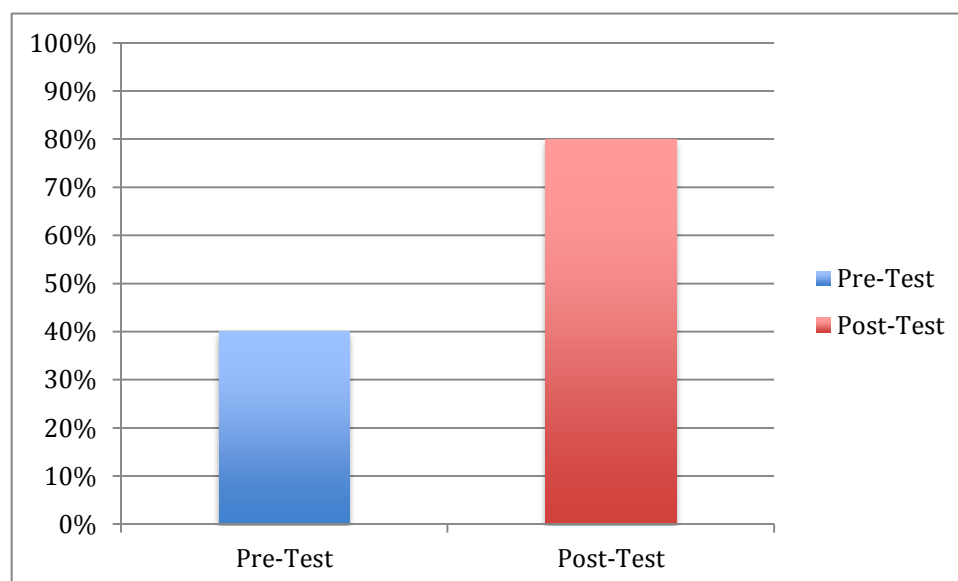


Figure 15: Graph comparing the pre-test and post-test average scores of low-achieving mathematics students.



Overall, the majority of students made sizeable gains between their pre-test and post-test accuracy scores. Three students kept the same score from the pre-test to the post-test and no students decreased in accuracy. Between the male students and the female students there were no noteworthy differences, both groups of students had similar accuracy scores and improvement percentages. The male students' average scores went from a 48% to an 86%, with a 38% increase while female students' average scores went from a 50% to an 89% with a 39% increase. The ELL students went from a pre-test average of 54% to a post-test average of 79%, a 25% increase in accuracy. The on-grade level mathematics students made the smallest change with an increase of 17%. The biggest change occurred in the below-grade level mathematics students whose averages went from a pre-test average of 40% to a post-test average of 80%, a 40% increase. The large increases in students' accuracy scores on the pre- and post-tests show that the use of the graphic organizer is beneficial for students' accuracy when solving word problems.

As a part of pre- and post-test oral assessments, students were asked if they thought they were good at mathematics in general. When students were asked if they were good at mathematics during the pre-test, 14 students said yes and 6 students said no. When asked the same question on the post-test, all 20 students said yes they thought they were good at mathematics. Out of all 20 students, 30% of students had an increase in their confidence in the mathematics classroom while 70% of students' confidence levels remained the same.

<b>Pre-Test Answer: Do you think you're good at math?</b>	<b>Post-Test Answer: Do you think you're good at math?</b>	<b>Number of Students</b>
Yes	Yes	14 (70%)
No	Yes	6 (30%)

*Figure 16:* Chart displaying students' pre- and post-test answers the question "Do you think you're good at math?"

In addition, as part of the pre- and post-test oral assessments students were asked the question “Do you think you are good at solving word problems?” to assess their confidence and attitude towards solving word problems. There were sizeable increases in students’ attitudes concerning word problems. During the pre-test, eight students said that they thought they were good at solving word problems and twelve students said no. During the post-test, all of the students said they were good at solving word problems. Among the 20 students in the study, 60% changed to having a positive attitude about word problems and showed an increase in their confidence level.

<b>Pre-Test Answer: Do you think you’re good at word problems?</b>	<b>Post-Test Answer: Do you think you’re good at word problems?</b>	<b>Number of Students</b>
Yes	Yes	8 (40%)
No	Yes	12 (60%)

*Figure 17:* Chart displaying students’ pre- and post-test answers to the question “Do you think you are good at solving word problems?”

In order to assess students approaches towards solving word problems, students were asked in the post-test if they liked using the graphic organizer to solve word problems, and why or why not. Students were also asked to explain their mathematical thinking by explaining how they solved a word problem. When asked whether or not they liked using the graphic organizer, 80% of students said yes and 20% of students said no. The students who said yes gave multiple reasons including the graphic organizer helps them organize, helps to break up the problem, and makes solving word problems neater and easier. The students who said no gave reasons including that there was too much writing or they were still confused on how to use the graphic organizer. Students also become more elaborate in their explanation of their mathematical thinking. Students shifted from a key word approach to examining the

problem as a whole. A below-grade level mathematics student began the pre-test by saying “I saw the word altogether so I knew to add” and ended the post-test saying “I saw the word altogether so I know to add” shifted to “I know Kathryn has 16 acorns and Alli has 83 acorns and I know they are collecting them together so I know the number has to get bigger so I know I am adding.” Another on-grade level mathematics student began looking at multi-step problems by only doing one step at a time before even reading the whole problem; however, during the post-test she looked at the whole problem and then dissected it into the sections of the graphic organizer.

### **Discussion**

The results of this study support the use of the graphic organizer in the elementary mathematics classroom. Students had an increase in accuracy and attitude when solving word problems. Though there were limitations during the study, overall students had great success and showed an elaboration in mathematical thinking.

### **Limitations**

Due to the nature of the elementary classroom, there were limitations in this study that have been divided into two subgroups: scheduling limitations and instructional limitations. These scheduling and instructional limitations impacted student use of the graphic organizer, however, students still showed engagement and success when using the graphic organizer.

### **Scheduling Limitations**

Spontaneous mandatory school-wide testing, snow days, and a lack of classroom instructional time caused the scheduling limitations. The original timeline of six weeks had to

be adapted due to nine snow days, and a week of unscheduled mandatory school-wide testing. The testing took away a whole week of morning instructional time, and during the afternoon regular classroom material had to be caught up on. The study still occurred over six weeks but three weeks of instructional time on the graphic organizer were lost.

### **Instructional Limitations**

The scheduling limitations had a substantial impact on instructional time. Due to the loss of three weeks of the study, both refresher lessons and lots of independent practice with the graphic organizer were taken out of the original timeline. Students were given the pre-test and taught how to use the graphic organizer through modeling and class discussion in week one. During weeks two through five, there was minimal instruction in the graphic organizer and minimal independent student use of the graphic organizer. The graphic organizer was available for students to use at any point during mathematics instruction but students were not retaught or refreshed on how to use the graphic organizer. During week five of the study, students were again shown how to use the graphic organizer through modeling as a class. This was a type of refresher lesson before the post-test following week six.

Despite the decrease in instructional time, students showed success and engagement in using the graphic organizer. During the three weeks of lost instructional time, students began drawing the graphic organizer on their own on class whiteboards during station time (Appendix F). Students were told that the graphic organizer was available at any time and students asked to use the graphic organizer during testing when solving classwork word problems. One of the areas students asked to use the graphic organizer was during Word Problem Wednesdays, a school-wide word problem improvement program. Though no

numerical data was collected, there was general student accuracy improvement for students who were struggling with word problems.

There were four students who said that they did not like using the graphic organizer to solve word problems. Two of those students said they did not like using the graphic organizer because it was still confusing for them. With a more consistent and lengthier instructional time, hopefully these students would not still be confused.

### **Coherence with the Literature**

This study directly coincided with the literature presented at the beginning of the study. In a third grade classroom, word problems are a crucial part of classroom instruction because they are a large part of the end of the year Standards of Learning tests. Students must have a conceptual understanding of mathematics topics and clear way of organizing their thinking to successfully solve a word problem. The graphic organizer allows a way for students to organize their thinking into neater sections. The three main responses for how the graphic organizer helps students solve word problems were that it helps students organize, helps students break up the problem, and makes their work neater. Of the sixteen students who said that the graphic organizer helps them solve word problems; eight students said it helps them organize; five said it helps them break up the problem, and three said their work was neater. Word problems can be very difficult for elementary students to solve and this graphic organizer supports and helps with word problems because it helps students organize their thoughts and examine the problem as whole.

Word problems are especially difficult for students who struggle with reading comprehension because they become overwhelmed by the number of words they are required to read and understand before even beginning to understand the problem. There were nine

low-readers who participated in this study; they were defined as low readers because they did not pass the beginning of the year reading level assessment. The nine readers who participated in the study also struggle in mathematics and with word problems because they have a lack of comprehension skills and often give up when the problems are too wordy. Out of the nine students who participated in the study, 55% of these nine students had an increase in confidence level when solving word problems. These students also said that the graphic organizer helped them by breaking up the problem and helping to put their work into sections. All of these students either kept the same accuracy level or increased in their academic performance. This graphic organizer supports low readers because it eliminates the need for these students to process insignificant information and helps to break up the problem to see the significant information.

This study showed similar outcomes with ELL students and male versus female students as shown in the literature. There was not a difference between the male students average scores and female students average scores. The majority of the ELL students scores increased and three of the students' scores stayed the same. The lack of major increase with ELL students could be due to the lack of consistent instruction and modeling of the graphic organizer that is most beneficial for ELL students.

This graphic organizer was successful in this elementary classroom because it allowed students to differentiate their work on their own as they solved the problem. Some students used the graphic organizer as a way to jot down quick notes while other students took full advantage and wrote full sentences with information they knew about the problem (Appendix G). Students were all given the same problem, but as stated in the literature, they took their own path to solve the problem.

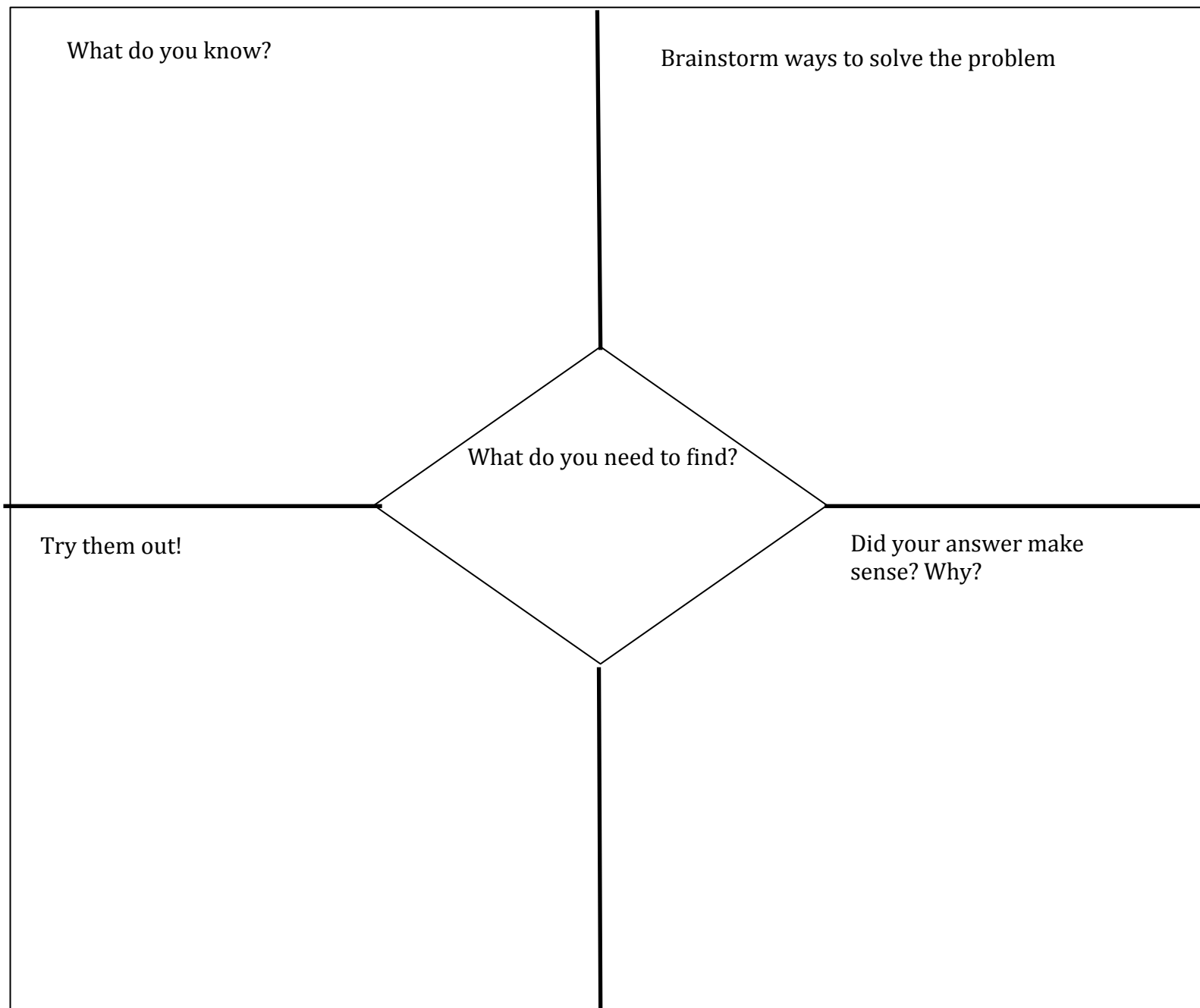
**Expansion**

This graphic organizer could be implemented in both upper and lower elementary grades. In an upper elementary grade students could be required to have more of a written explanation of their thinking and explain in detail why their answer makes sense. In a lower elementary grade the sections could be simplified and require less writing from students. This graphic organizer could also be modified for use in science; students could find a problem and explain what they know about the problem, how they were going to experiment, and then record their hypothesis and results.

**Conclusion**

This study examined the use of a graphic organizer in a third grade classroom in a high-need community in Central Virginia. The use of a graphic organizer in an elementary mathematics classroom can be very beneficial for students because it allows a place for students to organize their thoughts, sort significant and insignificant information, and self-differentiate. Further research with this graphic organizer could include a longer time frame that allows for flexibility with instruction of the graphic organizer and a stronger emphasis on independent student use. A study could also be conducted in a more consistent, stable environment where there are fewer interruptions to show the complete benefits of the graphic organizer.

## Appendix A





## Appendix B

1. Jason found 45 seashells and Alyssa found 83 seashells on the beach. How many seashells did they find together?
2. Michael has  $\frac{2}{5}$  cup of chocolate chips and  $\frac{1}{3}$  cup of candies, how many cups of food does he have?
3. George had 53 nickels in his piggy bank; he spent 28 of his nickels at the store. How many nickels does George have left?
4. Isabella is decorating a poster for her room; the poster is 3 feet by 4 feet. How many feet of ribbon will she need to decorate the perimeter of her poster?

## Appendix C

1. How did you start solving the problem? Why did you start there?
2. Do you like solving word problems?
3. Do you think you're good at solving word problems?
4. Do you like math?
5. Do you think you're good at math?

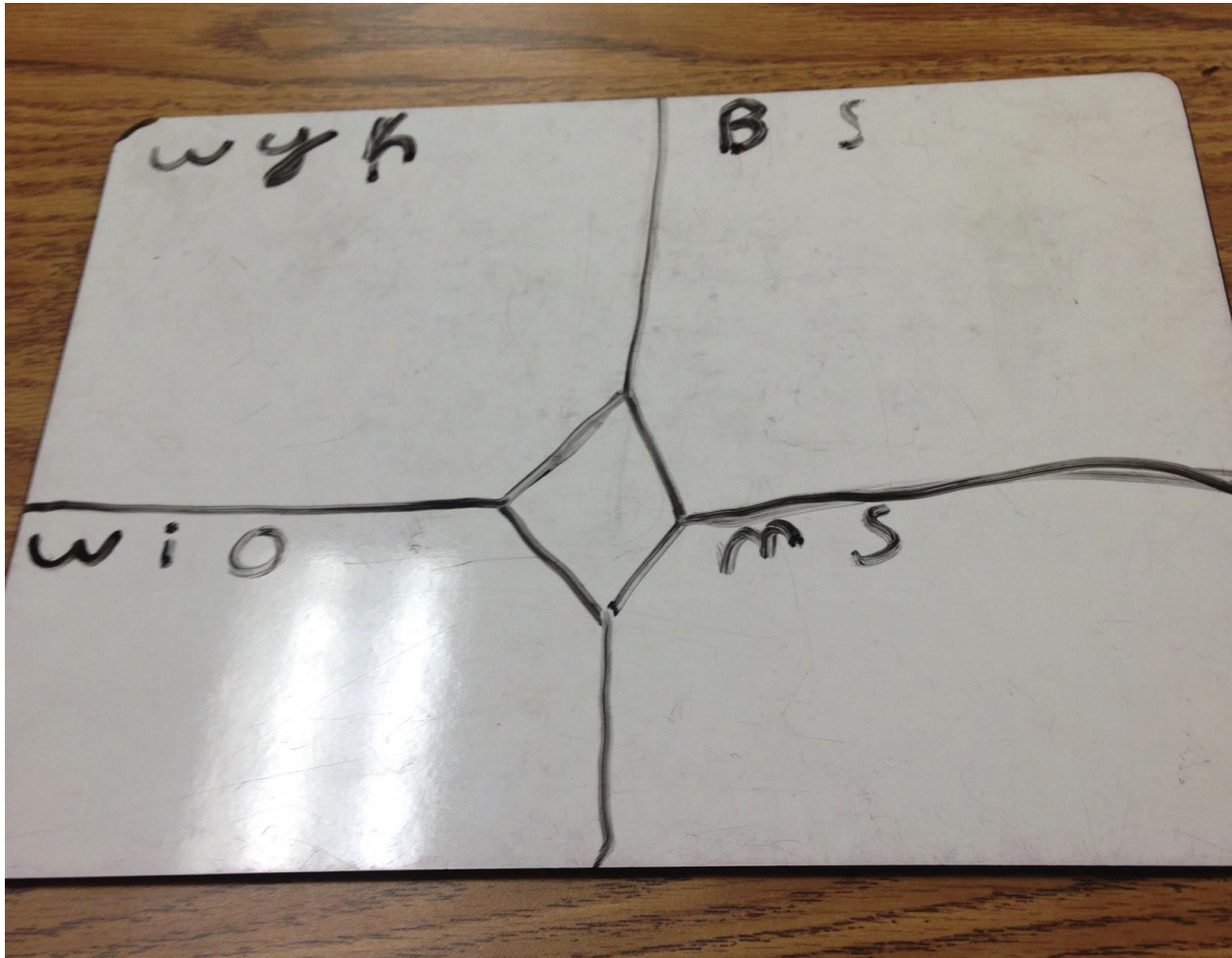
## Appendix D

1. How did you start solving the problem? Why did you start there?
2. Do you like solving word problems?
3. Do you think you're good at solving word problems?
4. Do you like math?
5. Do you think you're good at math?
6. Do you like using the graphic organizer? Why or why not?

## Appendix E

1. Kathryn found 16 acorns and Alli found 83 acorns in the yard. How many acorns did they find together?
2. Michael has  $\frac{2}{5}$  cup of flour and James has  $\frac{1}{5}$  cup of flour, how many cups of flour do they have?
3. Mr. Davis' yard is 12 feet wide and 7 feet long. What is the area of Mr. Davis' yard?
4. George had 53 buttons in a tin; he lost 28 of his buttons on the playground. How many buttons does George have left?

Appendix F



## Appendix G

What do you know?	Brainstorm ways to solve the problem
Nancy has $\frac{2}{5}$ cups of flour Iris has $\frac{1}{5}$ cups of flour	$\oplus$ - $\times$ $\div$
<div data-bbox="638 863 971 989">What do you need to find? how much do they have together</div>	
Work it out!	Did your answer make sense? Why?
$\frac{2}{5} + \frac{1}{5} = \frac{3}{5}$	Yes

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